

What is claimed is:

- 1 1. A method for estimating a remaining lifetime of a part in a piece of semiconductor  
2 fabrication equipment, comprising the steps of:  
3 selecting a plurality of factors relevant to the remaining lifetime of the part, the plurality  
4 of factors including a number of semiconductor wafers that have been processed by the piece of  
5 semiconductor fabrication equipment since the part was installed in the piece of equipment; and  
6 estimating the remaining lifetime of the part by a fuzzy inference.
- 1 2. The method of claim 1, wherein the plurality of factors include a length of time that the  
2 part has been used.
- 1 3. The method of claim 2, further comprising replacing the part when the estimated  
2 remaining lifetime falls below a threshold value.
- 1 4. The method of claim 2, wherein the fuzzy inference is based on the following fuzzy rule  
2 set, in which P is the number of semiconductor wafers that have been processed by the piece of  
3 semiconductor fabrication equipment since the part was installed in the piece of equipment, T is  
4 the length of time that the part has been used, and L is the remaining lifetime of the part:  
5 if P is small, and T is small, then L is large;  
6 if P is medium, and T is small, then L is medium;  
7 if P is large, and T is small, then L is small;  
8 if P is small, and T is medium, then L is large;  
9 if P is medium, and T is medium, then L is medium;  
10 if P is large, and T is medium, then L is small;  
11 if P is small, and T is large, then L is medium;  
12 if P is medium, and T is large, then L is medium; and  
13 if P is large, and T is large, then L is small.
- 1 5. The method of claim 2, wherein the fuzzy inference is based on a fuzzy rule set  
2 determined using empirical experience.

1 6. The method of claim 2, further comprising the step of automatically collecting the  
2 following data for the part: the number of semiconductor wafers that have been processed by the  
3 piece of semiconductor fabrication equipment since the part was installed in the piece of  
4 equipment, and the length of time that the part has been used.

1 7. The method of claim 1, wherein:  
2 the plurality of factors include a length of time that the part has been used;  
3 wherein the fuzzy inference is based on the following fuzzy rule set determined using  
4 empirical experience, in which P is the number of semiconductor wafers that have been  
5 processed by the piece of semiconductor fabrication equipment since the part was installed in the  
6 piece of equipment, T is the length of time that the part has been used, and L is the remaining  
7 lifetime of the part:

8 if P is small, and T is small, then L is large;

9 if P is medium, and T is small, then L is medium;

10 if P is large, and T is small, then L is small;

11 if P is small, and T is medium, then L is large;

12 if P is medium, and T is medium, then L is medium;

13 if P is large, and T is medium, then L is small;

14 if P is small, and T is large, then L is medium;

15 if P is medium, and T is large, then L is medium; and

16 if P is large, and T is large, then L is small.

1 8. A system for estimating a remaining lifetime of a part in a piece of semiconductor  
2 fabrication equipment, comprising:

3 means for automatically collecting and storing data representing the number of  
4 semiconductor wafers that have been processed by the piece of semiconductor fabrication  
5 equipment since the part was installed in the piece of equipment;

6 fuzzy inference means for determining degrees of fulfillment of a plurality of rules based  
7 on a plurality of factors relevant to the remaining lifetime of the part, the plurality of factors

8 including a number of semiconductor wafers that have been processed by the piece of  
9 semiconductor fabrication equipment since the part was installed in the piece of equipment; and  
10 a defuzzifier for estimating the remaining lifetime of the part based on the degrees of  
11 fulfillment of the plurality of rules.

1 9. The system of claim 8, wherein the plurality of factors include a length of time that the  
2 part has been used.

1 10. The system of claim 9, wherein the rules include the following fuzzy rule set, in which P  
2 is the number of semiconductor wafers that have been processed by the piece of semiconductor  
3 fabrication equipment since the part was installed in the piece of equipment, T is the length of  
4 time that the part has been used, and L is the remaining lifetime of the part:

5 if P is small, and T is small, then L is large;

6 if P is medium, and T is small, then L is medium;

7 if P is large, and T is small, then L is small;

8 if P is small, and T is medium, then L is large;

9 if P is medium, and T is medium, then L is medium;

10 if P is large, and T is medium, then L is small;

11 if P is small, and T is large, then L is medium;

12 if P is medium, and T is large, then L is medium; and

13 if P is large, and T is large, then L is small.